Comment on "Optical rogue waves in telecommunication data streams"

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Abstract: Despite its title and its general presentation, ref. 1 proves that rogue waves never exist in purely linear telecommunication systems.

A rare event in physics should nevertheless have a non negligible probability of occurrence when considering long durations. For technological issues like that of this paper; an event that has a weak probability to appear in, say, one million of years, simply does not exist at all. In optical linear systems, the common knowledge is that the probability of a giant fluctuation due to the constructive interference of a great number of random fields becomes rapidly vanishingly small, because of the central limit theorem. (eq.3 of ref.1).

Optical rogue waves are usually defined as rare giant events that nevertheless appear, because of nonlinearities, with a probability greater than the usual negative exponential given by the central limit theorem, ensuring their actual existence. In contrast, the pdf of eq. 5 of ref. 1 is, except for very small powers, smaller than the usual negative exponential of the power, eq.3. This simple fact precludes the existence of rogue waves in their usual sense. Moreover, it is straightforward to calculate from eq.3 an upper bound for the probability of occurrence of a fluctuation of the power P versus the mean power $\bar{P}$ as high or higher than that shown in fig.1b of ref.1. The result is $\exp(-P/\bar{P}) \approx 10^{-60}$, while $3\ 10^{24}$ bits can be transmitted at 100Gbit/s in one million of years.

To conclude this comment, the "giant statistical fluctuation" of fig.1 b does not correspond to any reality in the considered linear model and, more generally, ref.1 shows that the deviations of optical linear systems from the central limit theorem rend giant fluctuations even rarer than in the approximation of this theorem. Hence, ref. 1 does not in any way prove the existence of linear rogue waves.

References

[1] S. Vergeles and S.K. Turitsyn, "Optical rogue waves in telecommunication data streams", Phys. Rev A **83,** 061801, (2011)